* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the surface treatment approach of the silicon wafer for forming an oxide film in the surface contamination removal of a silicon wafer and the silicon wafer by which flattening processing was carried out, the silicon wafer manufacture approach, the oxide-film formation approach of a silicon wafer, the oxidation silicon wafer manufacture approach, oxygen active species ambient atmosphere formation equipment, and a flattening processing system.
[0002]
[Description of the Prior Art] The CMP equipment which grinds the front face of a silicon wafer mechanically and chemically has been used abundantly at flattening of a silicon wafer. However, in order to raise the display flatness of a silicon wafer in connection with the densification of a semiconductor, in recent years, the local etching system which etches a silicon wafer locally by the active species generated in the plasma has come to be used. Drawing 20 is the sectional view showing a general local etching system. This local etching system makes SF6 (6 sulfur fluorides) gas etc. discharge with a plasma generator 100, generates F active species etc., is injecting this F active species G on the front face Wa of the silicon wafer W on a chuck 120 from the nozzle section 101, and etches locally a part (henceforth the "relative thickness section") thicker than a criteria thickness value among the parts of a front face Wa. Flattening of the surface Wa ****** of a silicon wafer W is carried out by making late passing speed, i.e., the relative velocity of the nozzle section 101, for a chuck 120, specifically lengthening injection time of the F active species G to the thick relative thickness section, making relative velocity of the nozzle section 101 quick to the low relative thickness section, and shortening injection time of the F active species G.
[0003]
[Problem(s) to be Solved by the Invention] However, there are the following problems in the above-mentioned Prior art. Since SF6 gas is used from a viewpoint of an etch rate, the compound accompanied by few smells considered to be S (sulfur) or S compound from the silicon wafer W after local etching accumulates. Since the contamination in contamination, a cassette, etc. of the cleaning tank of a back process would be produced, leaving this soaks a silicon wafer W in liquids, such as pure water, and he was trying to flush S component etc. conventionally. However, only by liquids, such as pure water, washing, a smell could not remain, and it could not fully wash out from a silicon wafer W, but was anxious for a technical birth which removes this contamination. Moreover, the front face of the silicon wafer W by which flattening was carried out is activated, if a silicon wafer W is put into air, a silicon wafer W will adsorb the impurity in air, and the situation where a silicon wafer W is polluted will occur. Then, preventing contamination of a silicon wafer W is also considered by soaking the silicon wafer W after flattening in ozone water etc., and using the art which forms an oxide film in the front face of a silicon wafer W like a technique given in JP,10-135161,A. However, there is a problem of taking long duration to form the oxide film of predetermined thickness in the front face of a silicon wafer W on this technique. Furthermore, the above-mentioned local etching processing is dry processing, and if wet

processing in which it soaks in ozone water after this dry processing is performed, a washing process and a desiccation process will be needed for degree process, and its down stream processing will increase, and it will also produce the problem that facility cost becomes high.

[0004] It aims at offering the surface-treatment approach of the silicon wafer which can prevent the further contamination of the silicon wafer by which was made in order that this invention might solve the technical problem mentioned above, and could carry out surface-contamination removal of the silicon wafer with which surface contamination of [after local etching] was carried out in a short time, and flattening was carried out, the silicon-wafer manufacture approach, the oxide-film formation approach of a silicon wafer, the oxidation silicon-wafer manufacture approach, oxygen active-species ambient atmosphere formation equipment, and a flattening processing system.

[0005]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the surface treatment approach of the silicon wafer concerning invention of claim 1 The silicon wafer which carried out local etching by injecting the active species which the gas of a fluorine compound was made to discharge and was generated on the surface of a silicon wafer through a nozzle It considered as the configuration which performs surface treatment of a silicon wafer by putting into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and was generated, and removing the sulfur or the carbon system compound adhering to a silicon wafer. Since sulfur and the carbon component adhering to that of a silicon wafer are removed by this configuration and surface contamination removal is performed by it, the load of the washing process of a silicon wafer like before is mitigable. In addition, it is thought that surface contamination removal of a silicon wafer is based on the chemical reaction of oxygen active species, a sulfur component, or an oxygen active species and a carbon component. For this reason, surface treatment time amount is short and ends. Then, invention of claim 2 was taken as the configuration which puts a silicon wafer for [for / 10 seconds / -] 300 seconds into the ambient atmosphere of oxygen active species in the surface treatment approach of a silicon wafer according to claim 1 as a good example of surface treatment time amount. Moreover, the manufacture approach of a silicon wafer without surface contamination may also be enacted as invention of an approach. Then, the silicon wafer manufacture approach concerning invention of claim 3 The silicon wafer which carried out local etching by injecting the active species which the gas containing either SF6, CF4 or C2F6 was made to discharge, and was generated on the surface of a silicon wafer through a nozzle It considered as the configuration which manufactures the silicon wafer by which surface contamination removal was carried out by putting for [for / 10 seconds / -] 300 seconds into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and was generated, and removing the sulfur or the carbon system compound adhering to a silicon wafer.

[0006] The oxide-film formation approach of the silicon wafer concerning invention of claim 4 was put into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and generated the silicon wafer which carried out local etching by injecting the active species which predetermined gas was made to discharge and was generated on the surface of a silicon wafer through a nozzle, and was considered as the configuration which forms the silicon oxide of predetermined thickness in the whole silicon wafer. Since the oxide film is formed in the silicon wafer of this configuration, when a silicon wafer is put into air, by it, a silicon wafer does not adsorb the quality of an impurity in air. Although the thickness of an oxide film was arbitrary, invention of claim 5 considered thickness of silicon oxide as the configuration which is less than [of 5 to 50nm] as the good example in the oxide-film formation approach of a silicon wafer according to claim 4. Moreover, the manufacture approach of a silicon wafer that the oxide film of predetermined thickness was formed may also be enacted as invention of an approach. Then, the oxidation silicon-wafer manufacture approach concerning invention of claim 6 was considered as the configuration which manufactures the silicon wafer with which the silicon oxide of the less than thickness of 5 to 50nm was formed by putting into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and generated the silicon wafer which carried out local etching by injecting the active

species which predetermined gas was made to discharge and was generated on the surface of a silicon wafer through a nozzle.

[0007] By the way, the special equipment which can put the silicon wafer by which flattening processing was carried out into the ambient atmosphere of oxygen active species may also be materialized as invention of an object. Then, the oxygen active species ambient atmosphere formation equipment concerning invention of claim 7 The chamber which it has the gate for taking the silicon wafer by which flattening processing was carried out in and out, and can make the interior into an abbreviation vacua, The wafer supporter held where the front face by which was prepared in the chamber and flattening processing was carried out at least in the silicon wafer is exposed, The plasma generator which make opening of the nozzle section of the discharge tube open for free passage in a chamber, and the oxygen gas or oxygen mixed gas in the discharge tube is made to discharge, generates oxygen active species, and injects this oxygen active species in a chamber from opening of the nozzle section, It considered as the configuration possessing the gas supply machine for supplying oxygen gas or oxygen mixed gas in the discharge tube of a plasma generator. In this equipment, the surface treatment of a silicon wafer and the certainty of oxide-film formation are influenced according to the structure of a wafer supporter. Then, as an example of a wafer supporter, in oxygen active species ambient atmosphere formation equipment according to claim 7, a wafer supporter is in the condition in which most of whole surface surfaces by which flattening processing was carried out, and rear faces were exposed, and invention of claim 8 considered it as the configuration which is a chuck holding a silicon wafer by fixing less than 3mm of rear-face rim sections. Moreover, invention of claim 9 considered the wafer supporter as the configuration which is the wafer cassette which supports the rear face of a silicon wafer in the state of abbreviation point contact where the whole surface surface and the rear face where it has two or more stowages which can be contained, respectively, and flattening processing of each stowage was carried out in two or more silicon wafers are exposed as other examples in oxygen active species ambient atmosphere formation equipment according to claim 7.

[0008] Moreover, the flattening processing system which can perform the both sides of local etching processing and the processing put to oxygen active species may also be materialized as invention of an object. Then, the flattening processing system concerning invention of claim 10 as an example of this flattening processing system Where it is prepared in the chamber which can make the interior into an abbreviation vacua, and a chamber and most of whole surface surfaces of a silicon wafer and rear faces are exposed The chuck which holds a silicon wafer by adsorbing the rear-face rim section, The plasma generator which the gas in the discharge tube attached in the chamber in the condition of having made opening of the nozzle section countering on the surface of a silicon wafer is made to discharge, generates active species, and injects this active species from opening of the nozzle section, The local etching gas feeder for supplying the gas for local etching in the discharge tube of a plasma generator, It considered as the configuration possessing the oxygen gas feeder for supplying oxygen gas or oxygen mixed gas in the discharge tube of a plasma generator, and the flat-surface drive for moving a chuck so that the front face of a silicon wafer may move to opening of the nozzle section, and parallel. As other examples of a flattening processing system, furthermore, invention of claim 11 It is a flattening processing system possessing a local etching system, oxygen active species ambient atmosphere formation equipment, and a transport device. A local etching system By adsorbing a rear face, where it is prepared in the chamber which it has the gate for taking a silicon wafer in and out, and can make the interior into an abbreviation vacua, and this chamber and the front face of a silicon wafer is exposed The predetermined gas in the chuck holding a silicon wafer and the discharge tube attached in the chamber in the condition of having made opening of the nozzle section countering on the surface of a silicon wafer is made to discharge. The plasma generator which generates active species and injects this active species from opening of the nozzle section, So that the local etching gas feeder for supplying predetermined gas in the discharge tube of this plasma generator and the front face of a silicon wafer may move to opening of the nozzle section, and parallel It has a flat-surface drive for moving a chuck. Oxygen active species ambient atmosphere formation equipment The chamber which it has the gate for taking a silicon wafer in and out, and can make the interior into an abbreviation vacua, The wafer cassette which supports the

rear face of a silicon wafer in the state of abbreviation point contact where the whole surface surface and the rear face where it is prepared in this chamber, and has two or more stowages which can be contained, respectively for two or more silicon wafers, and local etching processing of each stowage was carried out are exposed, The plasma generator which make opening of the nozzle section of the discharge tube open for free passage in a chamber, and the oxygen gas or oxygen mixed gas in the discharge tube is made to discharge, generates oxygen active species, and injects this oxygen active species in a chamber from opening of the nozzle section, It has an oxygen gas feeder for supplying oxygen gas or oxygen mixed gas in the discharge tube of this plasma generator. A transport device It considered as the configuration which is what is conveyed in the stowage of a wafer cassette from a chuck, without having opened each gate of a local etching system and oxygen active species ambient atmosphere formation equipment, and putting the silicon wafer by which local etching processing was carried out to external air.

[0009] Moreover, the surface treatment approach of the silicon wafer concerning invention of claim 12 soaked the silicon wafer which carried out local etching by injecting the active species which the gas of the sulfur compound containing SF6 was made to discharge, and was generated on the surface of a silicon wafer through a nozzle predetermined time in ozone water or a hydrofluoric-acid water solution, and considered it as the configuration which removes the sulfur compound component adhering to a silicon wafer. Furthermore, the silicon-wafer manufacture approach concerning invention of claim 13 was considered as the configuration which manufactures the silicon wafer by which surface contamination removal was carried out by soaking the silicon wafer which carried out local etching by injecting the active species which the gas of the sulfur compound containing SF6 was made to discharge, and was generated on the surface of a silicon wafer through a nozzle predetermined time in ozone water or a hydrofluoric-acid water solution, and removing the sulfur compound component adhering to a silicon wafer.

[0010]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained with reference to a drawing.

(1st operation gestalt) Drawing 1 is the sectional view showing the flattening processing system concerning the 1st operation gestalt of this invention. The flattening processing system of this operation gestalt is equipped with a chamber 1, a chuck 2, a plasma generator 3, the local etching gas feeder 4, the oxygen gas feeder 5, the X-Y drive 6 as a flat-surface drive, and the Z drive 7.

[0011] A chamber 1 is a box for processing a silicon wafer W, and can make the interior an abbreviation vacuum with a vacuum pump 10.

[0012] A chuck 2 is a member which is arranged in a chamber 1, adsorbs the rear face of a silicon wafer W and holds it. This chuck 2 is a chuck of an electrostatic type, and has the function to adsorb a silicon wafer W by the force of static electricity. Drawing 2 is the sectional view showing a chuck 2, and drawing 3 is the top view. As shown in these drawings, the chuck 2 has the outer wall section 20 of the shape of a ring which supports the rim of a silicon wafer W, and the low wall section 21 for being formed inside [lower] the outer wall section 20, and supporting a silicon wafer W from a lower part. And three projection 21a of predetermined height protrudes on the top face of the low wall section 21. By this, the front face Wa of a silicon wafer W is turned upward, and it inserts into the outer wall section 20, and by carrying the rear face Wb of a silicon wafer W on [of three] projection 21a, a silicon wafer W adsorbs by the chuck 2, and most of whole surface Wa surfaces of a silicon wafer W and rear faces Wb will be exposed.

[0013] The plasma generator 3 shown in drawing 1 has the discharge tube 30, the microwave oscillator 31, and the waveguide 32, and has the function which injects the active species generated within the discharge tube 30 from nozzle section 30a. The discharge tubes 30 are the quartz discharge tube, the alumina discharge tube, etc., nozzle section 30a is formed in the lower limit section, and the delivery pipe 54 with which the local etching gas feeder 4 and the oxygen gas feeder 5 which are mentioned later were connected, respectively is connected to the upper limit section. Nozzle section 30a is inserted into a chamber 1 through hole 10a drilled in the top-face center section of the chamber 1, it is equipped with O

ring 11 between this hole 10a and nozzle section 30a, and between hole 10a and nozzle section 30a is held airtightly. Moreover, a duct 12 is formed in the perimeter of nozzle section 30a, and the reaction generation gas at the time of etching is discharged to the chamber 1 exterior by the drive of a vacuum pump 13. A microwave oscillator 31 is a magnetron and can oscillate microwave M of predetermined frequency. A waveguide 32 is for spreading microwave M oscillated from the microwave oscillator 31, and is extrapolated by the discharge tube 30 through the hole 33. The reflecting plate (short plunger) 34 which reflects microwave M and forms a standing wave is attached in the interior of the left-hand side edge of such a waveguide 32. Moreover, 3 stub tuner 35 which performs phase doubling of microwave M, and the isolator 36 which bends reflective microwave M which faces to a microwave oscillator 31 in the direction (the direction of a front face of drawing 1) of 90 degree are attached in the halfway of a waveguide 32.

[0014] The local etching gas feeder 4 is a device for supplying SF6 (6 sulfur fluorides) gas which is gas for local etching in the discharge tube 30 of a plasma generator 3, and has structure which connected the bomb 40 of SF6 gas with the delivery pipe 54 through the rate controller 41. On the other hand, the oxygen gas feeder 5 is a device for supplying O2 (oxygen) gas which is gas for oxygen active species generation in the discharge tube 30, and has structure which connected the bomb 50 of O2 gas with the delivery pipe 54 through the rate controller 51. In addition, signs 42 and 52 are bulbs.

[0015] The X-Y drive 6 is a device for moving a chuck 2, as the front face Wa of a silicon wafer W moves in parallel with opening 30b of nozzle section 30a. This X-Y drive 6 is a well-known device, moves a chuck 2 to right and left of drawing 1 with the X drive motor 60, and moves a chuck 2 and the X drive motor 60 to the space table flesh side of drawing 1 with the Y drive motor 61 at one. Such a X-Y drive 6 is connected with the chuck 2 through the chuck base material 62. Drawing 4 is the sectional view showing the chuck base material 62 of the X-Y drive 6, and drawing 5 is the top view. The chuck base material 62 is formed by four arm 62a combined in the shape of a cross joint, and point 62b of each arm 62a is bent up, and it is joined to the inferior surface of tongue of a chuck 2. And it is directly linked with the device section 63 for bond part 62c of four arm 62a to move a chuck 2 with the X drive motor 60. According to this structure, the gas in a chamber 1 results in the hole 22 of a chuck 2 through between arm 62a of the chuck base material 62, and contacts the whole abbreviation surface of the rear face Wb of a silicon wafer W. On the other hand, it sets to drawing 1 , and the Z drive 7 is a device for moving a chuck 2, and is supporting the X-Y drive 6 from the lower part so that the front face Wa of a silicon wafer W may approach and desert to opening 30b of nozzle section 30a. Specifically, the X-Y drive 6 whole is moved up and down with the Z drive motor 70. A control computer 67 performs drive control of such an X drive motor 60 of the X-Y drive 6, and the Y drive motor 61 and the Z drive motor 70 of the Z drive 7 based on a predetermined program.

[0016] Next, how to perform flattening processing of a silicon wafer W and after treatment is explained using the flattening processing system of this operation gestalt. First, the local etching art which is flattening processing is explained. Where a silicon wafer W is adsorbed by the chuck 2, while driving a vacuum pump 10 and changing the inside of a chamber 1 into a low pressure condition, a silicon wafer W is brought close to opening 30b of the discharge tube 30 by making the Z drive 7 drive and raising the X-Y drive 6 whole.

[0017] The bulb 42 of the local etching gas feeder 4 is opened in this condition, and SF6 gas in a bomb 40 is supplied in the discharge tube 30 through a rate controller 41 and a delivery pipe 54. While adjusting the opening of a bulb 42 and maintaining the pressure of SF6 gas to a predetermined pressure at this time, a rate controller 41 adjusts the flow rate of SF6 gas.

[0018] A microwave oscillator 31 is made to drive in parallel to supply of the SF6 above-mentioned gas. Then, SF6 gas which exists in a discharge part discharges, and the F (fluorine) active species G is generated by microwave M. And the F active species G is guided at nozzle section 30a, and is injected by the front face Wa of a silicon wafer W from opening 30b of nozzle section 30a.

[0019] In this condition, the X-Y drive 6 is made to drive with a control computer 67, and a silicon wafer W moves the adsorbed chuck 2 in the direction of X-Y in the shape of zigzag. That is, nozzle section 30a is made to scan in the shape of zigzag relatively to a silicon wafer W, as shown in drawing

6 . At this time, the relative velocity to the silicon wafer W of nozzle section 30a is set as the thickness of the relative thickness section so that an abbreviation inverse proportion may be carried out. If nozzle section 30a moves right above the non-relative thickness section W1 at high speed and comes above the relative thickness section W2 by this as shown in drawing 7 , a rate will be lowered according to the thickness of the relative thickness section W2. Consequently, the etching time over the relative thickness section W2 becomes long, and the relative thickness section W2 will be deleted evenly. Thus, flattening processing of a silicon wafer W ends the whole surface Wa surface by deleting evenly, carrying out local etching of the front face Wa of a silicon wafer W locally by the F active species G.

[0020] Next, after treatment of a silicon wafer W is performed. In the above-mentioned flattening processing, since SF6 gas is used as gas for local etching of a silicon wafer W, sulfur or a sulfur compound adheres to the front face Wa of a silicon wafer W. In such a case, the surface treatment approach of the silicon wafer this invention can be performed using this flattening processing system. That is, while stopping the plasma generator 3 and the local etching gas feeder 4 which are shown in drawing 1 , a vacuum pump 10 is driven, after discharging the gas which remains in a chamber 1 to the silicon wafer W exterior, the Z drive 7 is made to drive and a silicon wafer W is kept away from opening 30b of the discharge tube 30. The bulb 52 of the oxygen gas feeder 5 is opened in this condition, and O2 gas in a bomb 50 is supplied in the discharge tube 30 through a rate controller 51 and a delivery pipe 54. While adjusting the opening of a bulb 52 and maintaining the pressure of O2 gas to a predetermined pressure at this time, 51 adjusts the flow rate ofOrate-controller 2 gas.

[0021] If a microwave oscillator 31 is made to drive in parallel to supply of the O2 above-mentioned gas, O2 gas which exists in a discharge part will discharge, and the O (oxygen) active species G1 will be generated by microwave M. Then, the O active species G1 is injected from opening 30b of nozzle section 30a, it is spread in the chamber 1 whole, and the chamber 1 interior becomes the ambient atmosphere of the O active species G1. Consequently, S and the O active species G1 adhering to a silicon wafer W will react, what is SO2 gas will be conjectured, and this will evaporate from a silicon wafer W. In addition, the vapor pressure of SO2 is very small, since it evaporates immediately from a silicon wafer W, in a silicon wafer W, into the ambient atmosphere of the O active species G1, it is putting a grade for 10 second - 300 seconds, and decontamination of the silicon wafer W is carried out completely. Consequently, the surface treatment approach of a silicon wafer W will be attained, and the silicon wafer W without surface contamination will be manufactured.

[0022] Thus, the system of 1 not only can perform local etching processing and surface treatment, but according to the flattening processing system of this operation gestalt, it can offer the silicon wafer W of high quality without surface contamination by performing the surface treatment approach of a silicon wafer. Furthermore, the short processing time of for [10 seconds -] 300 seconds does not take a long time like [perfect decontamination of silicon wafer W is possible, and / in case of being wet process like before].

[0023] The artificer conducted the following comparative experiments that the above-mentioned effectiveness should be proved. First, local etching processing was performed. While making the 8 inches silicon wafer W specifically stick to the chuck 2 in the chamber 1 maintained by 2.0Torr(s) and opening the bulb 42 of the local etching gas feeder 4, a rate controller 41 is adjusted. Supply 300SCCM (s), i.e., SF6 300ml [per for 1 minute] gas, to the discharge tube 30 from a bomb 40, and microwave M of output 350W is oscillated from a microwave oscillator 31. SF6 gas was made to discharge and local etching processing of the silicon wafer W was carried out by the generated F active species G. This local etching processing was performed to the silicon wafer W of 11 sheets. Next, after setting the inside of a chamber 1 to 1.0Torr(s), while opening the bulb 52 of the oxygen gas feeder 5, the rate controller 51 was adjusted, O2 gas of 200SCCM(s) was outputted from the bomb 50, the discharge tube 30 was supplied, microwave M of output 120W was oscillated from the microwave oscillator 31, the O active species G1 was generated, the inside of a chamber 1 was made into the ambient atmosphere of the O active species G1, and surface treatment of the silicon wafer W of nine sheets was carried out, respectively. The time amount put into the O active species G1 ambient atmosphere of each silicon wafer W was made to differ at this time. That is, for 1 second, for 2 seconds, for 3 seconds, for 5 seconds, for 15 seconds, for 30

seconds, for 1 minute, for 2 minutes, and for 5 minutes put each silicon wafer W of the 1st sheet, the 2nd sheet, the 3rd sheet, the 4th sheet, the 5th sheet, the 6th sheet, the 7th sheet, the 8th sheet, and the 9th sheet into the O active species G1 ambient atmosphere, respectively Then, although the contamination remained about the silicon wafer W of 1st - the 3rd sheet, about the silicon wafer W put for [for / 5 seconds / -] 5 minutes to the silicon wafer W of 4th - the 9th sheet, i.e., O active species G1 ambient atmosphere, a contamination did not exist but nearly perfect decontamination was performed. On the other hand, about the silicon wafer W of the 11th sheet, decontamination was tried in the condition [**** / sentimentally] like the conventional approach with the 10th sheet. Pure water washed the silicon wafer W of the 10th sheet for 3 minutes, and, specifically, the liquid which mixed a sulfuric acid and hydrogen peroxide solution at a rate of 3 to 1 washed the silicon wafer W of the 11th sheet for 5 minutes. However, in spite of having performed these processings, in the silicon wafer W of the 11th sheet, the contamination remained with the 10th sheet, and decontamination was not successful. Nearly perfect decontamination can be performed by putting the silicon wafer W which carried out flattening processing with this flattening processing system a grade for - 300 seconds during small 10 seconds into the O active species G1 so that clearly from the above experiment.

[0024] By the way, as described above, the front face of the silicon wafer W by which flattening processing was carried out is activated. It is very high, and when this silicon wafer W is put into air, especially the activity of the silicon wafer W by which flattening was carried out by local etching is adsorbed in all the impurities in air, and its degree of contamination of a silicon wafer W is remarkable. However, the oxide-film formation approach of the silicon wafer which prevents contamination of a silicon wafer W can also be performed by using this flattening processing system. That is, like the case of the above-mentioned surface treatment, the Z drive 7 is made to drive, where a silicon wafer W is kept away from opening 30b of the discharge tube 30, with the oxygen gas feeder 5, O2 gas of a predetermined pressure and a predetermined flow rate is supplied to the discharge tube 30, the O active species G1 generated with the plasma generator 3 is diffused in the chamber 1 whole, and the chamber 1 interior makes it the ambient atmosphere of the O active species G1. Consequently, Si (silicon) and the O active species G1 of a silicon wafer W react, and the film of SiO2 (silicon oxide) is formed all over a silicon wafer W after predetermined time progress. Therefore, while the oxide-film formation approach of the silicon wafer which forms the silicon oxide of the less than thickness of 5 to 50nm all over silicon wafer W is realizable by putting a silicon wafer W predetermined time into the ambient atmosphere of the O active species G1, the silicon wafer with which the silicon oxide of the less than thickness of 5 to 50nm was formed can be manufactured.

[0025] Thus, the system of 1 not only can perform local etching processing and surface treatment, but according to the wafer flattening system of this operation gestalt, it can perform oxide-film formation processing. Consequently, the silicon wafer W of high quality without adhesion of an impurity can be offered. Since an oxide film is formed by the chemical reaction of the O active species G1 and silicon to the silicon wafer in the dry condition that local etching processing was carried out especially, the oxide film of request thickness can be formed in a short time with a dry condition, it is necessary to establish neither a washing process nor a desiccation process specially, and reduction of the part facility cost can be aimed at.

[0026] The artificer conducted the following comparative experiments that the above-mentioned effectiveness should be proved. When it put predetermined time into the ambient atmosphere of the O active species G1 under the above-mentioned conditions and these conditions to the silicon wafer W of 11 sheets among the silicon wafers W of 21 sheets which performed local etching processing under the above-mentioned conditions and these conditions, the result shown with the curve a of drawing 8 was obtained. On the other hand, when it soaked in predetermined time ozone water and the oxide film was formed like the conventional oxide-film formation approach to the remaining silicon wafer W of ten sheets, the result shown with the curve b of drawing 8 was obtained. By the way, as for the thickness of an oxide film, it is desirable that it is 5nm or more. It is because there is a possibility that the pure field which an oxide film was not formed in homogeneity but carried out flattening processing locally may be exposed when thinner than this thickness. On the other hand, by making it the thickness of 5nm or more,

an oxide film is formed in homogeneity on the surface of a silicon wafer, and can prevent contamination of a silicon wafer W completely. However, in order for an oxide film to grow up to be the thickness of 5nm or more, the conventional approach takes the long time amount of one days or more, so that clearly [in the curve b of drawing 8]. On the other hand, by the oxide-film formation approach of this operation gestalt, by putting a grade for 150 seconds, since an oxide film grows up to be the thickness of 5nm or more, it turns out that effectiveness is very high.

[0027] (2nd operation gestalt) Drawing 9 is the sectional view showing the flattening processing system concerning the 2nd operation gestalt of this invention, and drawing 10 is the outline top view of a flattening processing system. As shown in these drawings, the flattening processing system is equipped with the local etching system 8-1, oxygen active species ambient atmosphere formation equipment 8-2, and a transport device 9.

[0028] the local etching system 8-1 -- a chamber 1, chuck 2', a plasma generator 3, the local etching gas feeder 4, the X-Y drive 6, and the Z drive 7 -- having -- the flattening processing system of the 1st operation gestalt, and abbreviation -- although it has the same structure, since it is equipment aiming only at local etching processing of a silicon wafer W, there is also no chuck base material 62 which there is no oxygen gas feeder 5, and connects chuck 2' and the X-Y drive 6. Drawing 11 is the top view showing the structure of chuck 2', and drawing 12 is the sectional view. Chuck 2' has structure which protruded disc-like projection 21a' [a little] smaller than a silicon wafer W on the center section of disc-like low wall section 21', and protruded arc-shaped outer wall section 20' on it at the left-hand side section on low wall section 21'. And as shown in drawing 12 , the low wall section 21' inferior-surface-of-tongue center section is directly linked with the device section 63 of the X-Y drive 6. Thereby, the rear face Wb of a silicon wafer W can be adsorbed by projection 21a', and a silicon wafer W can be moved to level and the upper and lower sides with the X-Y drive 6 and the Z drive 7.

[0029] Such a local etching system 8-1 is airtightly connected with oxygen active species ambient atmosphere formation equipment 8-2. As shown in drawing 9 and drawing 10 , the gate valve 80 for taking a silicon wafer W in and out is formed in chamber 1' of oxygen active species ambient atmosphere formation equipment 8-2, and, specifically, the chamber 1 of the local etching system 8-1 and chamber 1' of oxygen active species ambient atmosphere formation equipment 8-2 are airtightly connected with it through this gate valve 80. Vacuum-pump 10' can be prepared in such chamber 1' of oxygen active species ambient atmosphere formation equipment 8-2, and the interior of chamber 1' can be made now into an abbreviation vacuum. And plasma generator 3' of the plasma generator 3 of the local etching system 8-1 and this structure is prepared in the chamber 1' bottom, the discharge tube 30 is attached in the top face of chamber 1', and opening 30b of the nozzle section 30a is open for free passage with the interior of chamber 1'. In addition, since this oxygen active species ambient atmosphere formation equipment 8-2 is equipment which makes the inside of chamber 1' the ambient atmosphere of the O active species G1, only the oxygen gas feeder 5 is connected to plasma generator 3'. That is, the bomb 50 of O2 gas is connected with a delivery pipe 54 through a rate controller 51 and a pump 52, and the delivery pipe 54 is connected to the upper limit section of the discharge tube 30 of plasma generator 3'.

[0030] Moreover, the wafer cassette 81 is arranged in chamber 1' of oxygen active species ambient atmosphere formation equipment 8-2. Drawing 13 is the perspective view showing the wafer cassette 81. As shown in drawing 13 , the wafer cassette 81 has 25 steps of stowages 83 held at four stanchions 82, and can contain a silicon wafer W now to the stowage 83 of each stage. A stowage 83 joins the cross-joint-like plate 85 to a frame 84, and has structure on which the projection 86 for carrying the rear face Wb of a silicon wafer W on a plate 85 protruded. That is, four projections 86 and the rear face Wb of a silicon wafer W will be in a point contact condition, and the stowage 83 has structure which most of front faces Wa of a silicon wafer W and rear faces Wb expose, when a silicon wafer W is put on four projections 86 of a stowage 83 and is contained.

[0031] The equipment which conveys the silicon wafer W by which local etching was carried out by the local etching system 8-1 to each stowage 83 of the above-mentioned wafer cassette 81 is the transport device 9 shown in drawing 9 and drawing 10 . This transport device 9 is a robot, and as shown in

drawing 9 , it is arranged in chamber 1'. This robot 9 consists of two or more arms 91 in which the hand 90 was attached, and a mechanical component 92 for moving this arm and hand 90. Hands 90 are the pawls 93 and 94 of the pair opened and closed by control of a mechanical component 92, as shown in drawing 11 . The set-up support sections 95 and 95 in which it becomes abbreviation semicircle-like at the time of close, and the bore spreads abbreviation etc. on the diameter of a silicon wafer W are formed in these pawls 93 and 94. And the supporter 96 for supporting the supported silicon wafer W from the bottom is formed in the inside lower part of the support sections 95 and 95, and the projection 97 for carrying a silicon wafer W protrudes on this supporter 96.

[0032] In drawing 10 , signs 98 are loading / unload room, into this loading / unload room 98, the cassette 99 which contained the unsettled silicon wafer W is placed, and a robot 9 takes out the wafer cassette 81 which contained the processed silicon wafer W of 25 sheets in loading / unload room 98 while carrying in one silicon wafer W in this cassette 99 at a time in the local etching system 8-1.

[0033] Next, the actuation which the flattening processing system of this operation gestalt shows is explained. First, in the local etching system 8-1, the same local etching processing as the 1st operation gestalt is performed. That is, SF6 gas is supplied to the discharge tube 30 of a plasma generator 3 from the bomb 40 of the local etching gas feeder 4, and local etching of the silicon wafer W on chuck 2' is carried out by the F active species G generated by discharge by the microwave oscillator 31.

[0034] After this local etching processing is completed, and the inside of a chamber 1 is made into an abbreviation vacuum by the vacuum pump 10, the arm 91 of the robot 9 controlled by the mechanical component 92 advances into the chamber 1 of the local etching system 8-1, and takes out the silicon wafer W of chuck 2' by the hand 90. The supporter 96 of pawls 93 and 94 is carried on low wall section 21of chuck 2' ', and it is made to advance into the silicon wafer W bottom, as it is in the condition which specifically opened a little the pawls 93 and 94 of the hand 90 shown in drawing 11 and is shown in drawing 14 . And as shown in drawing 1515 by raising the hand 90 whole just before the tip of pawls 93 and 94 runs against outer wall section 20', a silicon wafer W is taken out from chuck 2' in the condition of having appeared in the projection 97.

[0035] After an appropriate time, a robot 9 draws the taken-out silicon wafer W in chamber 1' of oxygen active species ambient atmosphere formation equipment 8-2, and contains to the stowage 83 of the first stage eye of the wafer cassette 81 shown in drawing 13 . A hand 90 is brought to near right above a stowage 83, pawls 93 and 94 are specifically opened, it is dropping a silicon wafer W quietly on the projection 86 of a stowage 83, and a silicon wafer W is contained to a stowage 83. Thus, after the robot 9 after containing the silicon wafer [finishing / local etching processing] W to a stowage 83 picks out the unsettled silicon wafer W from a cassette 99 using gate valve 98a of loading / unload room 98 and carries in to the local etching system 8-1, he returns an arm 91 in oxygen active species ambient atmosphere formation equipment 8-2, and stands by. In this condition, the gate valve 80 of oxygen active species ambient atmosphere formation equipment 8-2 and gate valve 98a of loading / unload room 98 close, and local etching processing of a silicon wafer W of the 2nd sheet is performed in the local etching system 8-1.

[0036] In parallel to this actuation, oxygen active species ambient atmosphere formation actuation is performed in oxygen active species ambient atmosphere formation equipment 8-2. That is, O2 gas is supplied in the discharge tube 30 of plasma generator 3' through a rate controller 51, a bulb 52, and a delivery pipe 54 from the bomb 50 of the oxygen gas feeder 5, and the O active species G1 generated by discharge by the microwave oscillator 31 is injected in chamber 1' from opening 30b of nozzle section 30a, and is full in chamber 1'. By this, the whole abbreviation surface of the silicon wafer W contained by the stowage 83 of the first stage of the wafer cassette 81 will be put to the O active species G1.

[0037] And after the local etching processing to the silicon wafer W of the 2nd sheet is completed in the local etching system 8-1, and the inside of the chamber 1 of the local etching system 8-1 and oxygen active species **** formation equipment 8-2 is made into an abbreviation vacuum, a gate valve 80 can open and this silicon wafer W of the 2nd sheet is contained with a robot 9 by the stowage 83 of the 2nd step of the wafer cassette 81. Henceforth, same local etching processing and processing put into an oxygen active species ambient atmosphere are performed about the silicon wafer W from the 3rd sheet

to the 25th sheet.

[0038] By the way, after containing the silicon wafer W of the 25th sheet to the stowage 83 of the 25th step, the decontamination of all the silicon wafers W including the silicon wafer W of the 25th sheet becomes possible because for [for / 10 seconds / -] 300 seconds puts this silicon wafer W to the O active species G1 with oxygen active species ambient atmosphere formation equipment 8-2. Moreover, an oxide film with a thickness of 5nm or more can be formed all over a silicon wafer W by putting the silicon wafer W of the 25th sheet to the 150 second or more O active species G1. Since the silicon wafer W to 1st - the 24th sheet is put to the O active species G1 until the silicon wafer W of the 25th sheet is contained by the wafer cassette 81 after these silicon wafers W are contained by the wafer cassette 81 at this time, the decontamination and oxide-film formation to the silicon wafer W of these 24 sheets will fully be performed. That is, supposing it is 3 minutes, it means that the processing time in the local etching system 8-1 was put 10 seconds or more for example, into the O active species G1 for 72 minutes at the time of decontamination after the silicon wafer W of the 1st above-mentioned sheet was contained by the wafer cassette 81, and decontamination is carried out nearly completely. Moreover, at the time of oxide-film formation processing, the silicon wafer W of the 1st sheet will be put 10 seconds or more into the O active species G1 for 72 minutes, and the thickness of the oxide film of this silicon wafer W is set to estimated 40nm or more.

[0039] Thus, according to the flattening processing system of this operation gestalt, since another equipment can perform continuously local etching processing, surface treatment, or oxide-film formation processing, compared with the flattening processing system of the 1st operation gestalt, a throughput is very high. Moreover, since the silicon wafer W before that is put into the O active species G1 until the surface treatment of the last silicon wafer W and oxide-film formation processing are completed, the decontamination of these silicon wafers W and the time amount for oxide-film formation are securable for a long time. Since other configurations and the operation effectiveness are the same as the operation gestalt of the above 1st, the publication is omitted.

[0040] (3rd operation gestalt) Drawing 16 is a showing [the flattening processing system for performing the surface treatment approach of the silicon wafer which is the 3rd operation gestalt of this invention] sectional view. As shown in drawing 16 , this flattening processing system is equipped with the local etching system 8-1 applied to the operation gestalt of the above 2nd, and the tub 86 which stored the hydrofluoric-acid water solution 85. By this configuration, the silicon wafer W processed by the local etching system 8-1 can be soaked in a tub 86 more than for 1 minute, and the sulfur compound component adhering to a silicon wafer W can be removed. Since other configurations and the operation effectiveness are the same as the operation gestalt of the above 2nd, the publication is omitted.

[0041] In addition, this invention is not limited to the above-mentioned operation gestalt, and various deformation and modification are possible for it within the limits of the summary of invention. Although the plasma generator 3 which oscillates microwave and generates the plasma as a plasma generator was used with the above-mentioned operation gestalt, various kinds of plasma generators, such as a plasma generator which generates the plasma and generates active species by the RF that what is necessary is just the device which can generate active species, can be used. Moreover, with the above-mentioned operation gestalt, as gas for local etching processing, although SF6 gas was used, the gas of all fluorine compounds can be used as gas for local etching processing. When being especially premised on forming an oxide film to a silicon wafer, the gas of not only the gas containing a sulfur compound but all halogenated compounds can be used as gas for local etching processing. Moreover, with the above 1st and the 2nd operation gestalt, as the object for surface treatment, and gas for oxide-film formation, although the gas of only oxygen was used, what mixed other gas can be used for oxygen gas as the object for surface treatment, and gas for oxide-film formation. Moreover, although the projection 97 was formed in a robot's 9 hand 90 with the operation gestalt of the above 2nd, it is good also as structure of putting a silicon wafer W on a supporter 96 directly, without forming projection 97. Moreover, with the operation gestalt of the above 2nd, the discharge tube 30 was attached in the top face of chamber 1' in plasma generator 3' of oxygen active species ambient atmosphere formation equipment 8-2. However, since this equipment is sufficient if the inside of chamber 1' is made to the ambient atmosphere of the O

active species G1, as long as opening 30b of nozzle section 30a is open for free passage with chamber 1', the attaching position of the discharge tube 30 is arbitrary. Moreover, although the robot 9 was arranged with the operation gestalt of the above 2nd in chamber 1' of oxygen active species ambient atmosphere formation equipment 8-2, as shown in drawing 17 , it is good also as a configuration which establishes a chamber 1-1 specially between the local etching system 8-1 and oxygen active species ambient atmosphere formation equipment 8-2, and arranges a robot 9 in this chamber 1-1. Thus, as shown in drawing 18 , the flattening processing system of a multi chamber method can consist of constituting. That is, a throughput can be further raised by connecting loading / unload room 98 of 1 with the polygonal chamber 1-1 as two or more local etching systems 8-1 and one oxygen active species ambient atmosphere formation equipment 8-2. Furthermore, with the 3rd operation gestalt, as a decontamination solution, although the hydrofluoric-acid water solution 85 was used, even if it uses ozone water, decontamination of the silicon wafer can be carried out. moreover -- the above -- the -- one -- operation -- a gestalt -- setting -- a silicon wafer -- W -- surface preparation -- an approach -- and -- an oxide film -- formation -- an approach -- performing -- the time -- a hole -- 22 -- having had -- a chuck -- two -- a silicon wafer -- W -- having held -- although -- drawing 19 -- being shown -- as -- a hole -- not having -- being disc-like -- a chuck -- two -- " -- a silicon wafer -- W -- having held -- a condition -- it is -- the above -- an approach -- performing -- things -- excepting -- a thing -- it is not .

[0042]

[Effect of the Invention] As explained in detail above, according to invention of claim 1 thru/or claim 3, claim 12, and claim 13, the silicon wafer of high quality without contamination can be offered. Furthermore, the perfect decontamination of a silicon wafer is possible for especially invention of claim 1 thru/or claim 3 at the short processing time. Moreover, according to invention of claim 4 and claim 5, the silicon wafer of high quality without adhesion of an impurity can be offered. Moreover, since an oxide film is formed by the chemical reaction of oxygen active species and silicon, the oxide film of request thickness can be formed in a short time. Furthermore, since an oxide film can be formed to the silicon wafer in the dry condition that local etching processing was carried out, with a dry condition, it is necessary to establish neither a washing process nor a desiccation process specially, and reduction of the part facility cost can be aimed at. Furthermore, according to invention of claim 7 thru/or claim 9, the silicon wafer front face considered that sulfur or a carbon system compound component has adhered so much can be put into an oxygen active species ambient atmosphere, and can carry out decontamination. Since oxygen active species can be especially contacted all over the abbreviation for a silicon wafer according to invention of claim 8 and claim 9, decontamination of a silicon wafer and formation of an oxide film can be ensured. Moreover, according to invention of claim 10, the system of 1 can perform local etching processing and decontamination processing, and flattening processing-system ****** concerning invention of claim 11 and the system of 1 can perform local etching processing and oxide-film formation processing.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The surface-treatment approach of the silicon wafer characterized by what surface treatment of a silicon wafer is performed for by putting into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and generated the silicon wafer which carried out local etching by injecting the active species which the gas of a fluorine compound was made to discharge and was generated on the surface of a silicon wafer through a nozzle, and removing the sulfur or the carbon system compound adhering to a silicon wafer.
[Claim 2] The surface treatment approach of the silicon wafer characterized by what the above-mentioned silicon wafer is put for [for / 10 seconds / -] 300 seconds into the ambient atmosphere of the above-mentioned oxygen active species in the surface treatment approach of a silicon wafer according to claim 1.
[Claim 3] The silicon wafer which carried out local etching by injecting the active species which the gas containing either SF6, CF4 or C2F6 was made to discharge, and was generated on the surface of a silicon wafer through a nozzle By putting for [for / 10 seconds / -] 300 seconds into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and was generated, and removing the sulfur or the carbon system compound adhering to a silicon wafer The silicon wafer manufacture approach characterized by what the silicon wafer by which surface contamination removal was carried out is manufactured for.
[Claim 4] The oxide-film formation approach of the silicon wafer characterized by what it puts into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and generated the silicon wafer which carried out local etching by injecting the active species which predetermined gas was made to discharge and was generated on the surface of a silicon wafer through a nozzle, and the silicon oxide of predetermined thickness is formed in the whole silicon wafer for.
[Claim 5] It is the oxygen film formation approach of the silicon wafer characterized by what the thickness of the above-mentioned silicon oxide is less than [of 5 to 50nm] in the oxide-film formation approach of a silicon wafer according to claim 4.
[Claim 6] The oxidation silicon wafer manufacture approach characterized by what the silicon wafer with which the silicon oxide of the less than thickness of 5 to 50nm was formed by putting into the ambient atmosphere of the oxygen active species which oxygen gas or oxygen mixed gas was made to discharge, and generated the silicon wafer which carried out local etching by injecting the active species which predetermined gas was made to discharge and was generated on the surface of a silicon wafer through a nozzle is manufactured for.
[Claim 7] The chamber which it has the gate for taking the silicon wafer by which flattening processing was carried out in and out, and can make the interior into an abbreviation vacua, The wafer supporter held where the front face by which was prepared in the above-mentioned chamber and flattening processing was carried out at least in the above-mentioned silicon wafer is exposed, The plasma generator which make opening of the nozzle section of the discharge tube open for free passage in the

above-mentioned chamber, and the oxygen gas or oxygen mixed gas in the discharge tube is made to discharge, generates oxygen active species, and injects this oxygen active species in the above-mentioned chamber from opening of the above-mentioned nozzle section, Oxygen active species ambient atmosphere formation equipment characterized by providing the gas supply machine for supplying the above-mentioned oxygen gas or oxygen mixed gas in the discharge tube of the above-mentioned plasma generator.

[Claim 8] It is oxygen active species ambient atmosphere formation equipment characterized by what it is in the condition in which most of whole surface surfaces where flattening processing of the above-mentioned wafer supporter was carried out [above-mentioned] in oxygen active species ambient atmosphere formation equipment according to claim 7, and rear faces were exposed, and is been the chuck which holds the above-mentioned silicon wafer by fixing less than 3mm of rear-face rim sections.

[Claim 9] It is oxygen active-species ambient atmosphere formation equipment characterized by what is been the wafer cassette which supports the rear face of a silicon wafer in the state of abbreviation point contact where the whole surface surface and the rear face where the above-mentioned wafer supporter has two or more stowages which can be contained, respectively for two or more above-mentioned silicon wafers in oxygen active species ambient atmosphere formation equipment according to claim 7, and flattening processing of each stowage was carried out [above-mentioned] are exposed.

[Claim 10] Where it is prepared in the chamber which can make the interior into an abbreviation vacua, and the above-mentioned chamber and most of whole surface surfaces of a silicon wafer and rear faces are exposed The chuck which holds the above-mentioned silicon wafer by adsorbing the rear-face rim section, The plasma generator which the gas in the discharge tube attached in the above-mentioned chamber in the condition of having made opening of the nozzle section countering the front face of the above-mentioned silicon wafer is made to discharge, generates active species, and injects this active species from opening of the above-mentioned nozzle section, The local etching gas feeder for supplying the gas for local etching in the discharge tube of the above-mentioned plasma generator, So that the oxygen gas feeder for supplying the above-mentioned oxygen gas or oxygen mixed gas in the discharge tube of the above-mentioned plasma generator and the front face of the above-mentioned silicon wafer may move to opening of the above-mentioned nozzle section, and parallel The flattening processing system characterized by providing the flat-surface drive for moving the above-mentioned chuck.

[Claim 11] It is a flattening processing system possessing a local etching system, oxygen active species ambient atmosphere formation equipment, and a transport device. The above-mentioned local etching system By adsorbing a rear face, where it is prepared in the chamber which it has the gate for taking a silicon wafer in and out, and can make the interior into an abbreviation vacua, and this chamber and the front face of a silicon wafer is exposed The predetermined gas in the chuck holding the above-mentioned silicon wafer and the discharge tube attached in the above-mentioned chamber in the condition of having made opening of the nozzle section countering the front face of the above-mentioned silicon wafer is made to discharge. The plasma generator which generates active species and injects this active species from opening of the above-mentioned nozzle section, So that the local etching gas feeder for supplying the above-mentioned predetermined gas in the discharge tube of this plasma generator and the front face of the above-mentioned silicon wafer may move to opening of the above-mentioned nozzle section, and parallel It has a flat-surface drive for moving the above-mentioned chuck. Oxygen active species ambient atmosphere formation equipment The chamber which it has the gate for taking the above-mentioned silicon wafer in and out, and can make the interior into an abbreviation vacua, The wafer cassette which supports the rear face of a silicon wafer in the state of abbreviation point contact where the whole surface surface and the rear face where it is prepared in this chamber, and has two or more stowages which can be contained, respectively for two or more above-mentioned silicon wafers, and local etching processing of each stowage was carried out [above-mentioned] are exposed, The plasma generator which make opening of the nozzle section of the discharge tube open for free passage in the above-mentioned chamber, and the oxygen gas or oxygen mixed gas in the discharge tube is made to discharge, generates oxygen active species, and injects this oxygen active species in the

above-mentioned chamber from opening of the above-mentioned nozzle section, It has an oxygen gas feeder for supplying the above-mentioned oxygen gas or oxygen mixed gas in the discharge tube of this plasma generator. The above-mentioned transport device The flattening processing system characterized by what is been what is conveyed in the stowage of the above-mentioned wafer cassette from the above-mentioned chuck, without opening each gate of the above-mentioned local etching system and oxygen active species ambient atmosphere formation equipment, and putting the silicon wafer by which local etching processing was carried out to external air.

[Claim 12] The surface treatment approach of the silicon wafer characterized by what the silicon wafer which carried out local etching by injecting the active species which the gas of the sulfur compound containing SF6 was made to discharge, and was generated on the surface of a silicon wafer through a nozzle is soaked in ozone water or a hydrofluoric-acid water solution predetermined time, and the sulfur compound component adhering to a silicon wafer is removed for.

[Claim 13] The silicon wafer manufacture approach characterized by what the silicon wafer by which surface contamination removal was carried out by soaking the silicon wafer which carried out local etching by injecting the active species which the gas of the sulfur compound containing SF6 was made to discharge, and was generated on the surface of a silicon wafer through a nozzle predetermined time in ozone water or a hydrofluoric-acid water solution, and removing the sulfur compound component adhering to a silicon wafer is manufactured for.

[Translation done.]